



Effect of rock strength on exhumation and the thermochronologic record: The south-central Colorado example

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Past work has used the Southern Rocky Mountains (SRM) in the U.S. state of Colorado to illustrate the important role that rock strength plays in the histories recorded by the apatite fission track (AFT) and apatite (U-Th)/He (AHe) low-temperature thermochronometers (Flowers & Ehlers, 2018). The SRM were initially raised during the Laramide Orogeny, ca. 70-45 Ma, but consensus exists that the region also experienced a later, post-Laramide exhumation event. Flowers & Ehlers (2018) pointed to the low erosion potential of the Precambrian crystalline basement rocks that crop out in most SRM ranges as a primary reason for the abundance of 55-70 Ma “Laramide” AFT and AHe dates in the region, compared to a paucity of younger dates that would presumably be produced through erosion triggered by the post-Laramide exhumation event. South-central Colorado offers a test of this hypothesis, due to lateral variations in rock erodibility provided by the presence here of both sedimentary and crystalline Laramide ranges and adjacent sedimentary basins. The combination of our ongoing AHe study with previous south-central Colorado AFT and AHe work reveals kilometer-scale post-Laramide (Oligo-Miocene) exhumation has occurred in areas that possess thick sedimentary rock sequences whereas exhumation has been negligible where crystalline basement comprises the land surface.

South-central Colorado’s Sangre de Cristo Mountains consist of an imbricate stack of thrust sheets composed of Permian sedimentary rock. About 30 km farther east stand the Wet Mountains, another Laramide range – but one composed of Precambrian basement rock. The Raton Basin, a SRM foreland basin filled with 2 km of synorogenic fill underlain by a thick sequence of marine shale, lies south and east of the two ranges. The Wet Mountains thus form a peninsula of strong crystalline rock surrounded by more erodible sedimentary rocks to the west, south, and east.

Our study and that of Landman (2018) records at least 2 km of erosion in the Raton Basin east and south of the Wet Mountains since 25 Ma. Lindsey et al (1986) obtained 24-15 Ma AFT dates from the Paleozoic sedimentary rocks of the Sangre de Cristo Mountains, demonstrating that kilometer-scale Oligo-Miocene exhumation occurred just west of the Wet Mountains. By contrast, Kelley and Chapin (2004) obtained only pre-Laramide AFT ages between 228-110 Ma for 17 samples of Precambrian basement from the crest of the Wet Mountains. A 32 Ma ash flow tuff unconformably overlies Precambrian basement on Greenhorn Mountain, the Wet Mountains’ highest and southernmost peak. Its presence reinforces the conclusion, based on the AFT dates, that Oligo-

Miocene erosion of the Wet Mountain massif has been minimal simultaneous with kilometer-scale exhumation to the west, south, and east. These results illustrate the important role that rock strength plays in determining the dates recorded in low-temperature thermochronologic studies.